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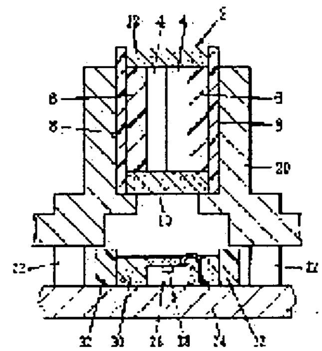
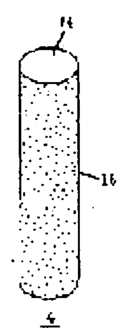
(54) IMAGING DEVICE

(57)Abstract:

PURPOSE: To prevent a lens array from deteriorating in imaging performance due to flare light so as to improve an imaging device in performance by a method wherein the side faces of lenses are roughened as prescribed in average roughness, and a light absorbing resin layer specified in transmissivity to light of wavelengths larger than that of operating light is provided among lenses.





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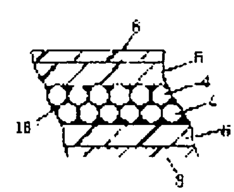

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CONSTITUTION: A lens array 2 is formed through such a manner that rod-like lenses 4 in continuous lengths are bound together, fixed by side plates 6, and cut into pieces. As the end face of the lens 4 is so roughened at cutting as to scatter light that travels through it, both the end faces of the lens 4 are covered with transparent resin layers 10 and 12. The side face 16 of the lens 4 is so roughened as to be 0.5 to 5μm in average roughness, and a light absorbing resin layer 18 whose transmissivity is below 20% to light of wavelengths larger than that of operating light is provided among the lenses 4. Therefore, flare light is restrained from being produced in a lens array, so that an imaging device of this constitution can be improved in image quality.

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CLAIMS

[Claim(s)]
[Claim 1] Picture equipment characterized by providing the following. The lens array which banded many cylindrical lenses together. Permeability is 20% or less of optical-absorption resin layer to the light of the wavelength more than the wavelength of the light used by the carrier light emitting device between each aforementioned lenses while split-face-izing the flank front face of each aforementioned lens and setting the average surface roughness to 0.5-5 micrometers in the picture equipment using many carrier light emitting devices.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Application of the Invention] This invention relates to the picture equipment which used a carrier light emitting device and lens arrays, such as a Light Emitting Diode head, a contact type image sensor and a liquid crystal shutter array head, and a PLZT head. Especially this invention relates to improvement of the lens array to be used.
[0002]
[Description of the Prior Art] With picture equipments, such as a Light Emitting Diode head and a contact type image sensor, lens arrays, such as a self-focusing lens array, are used. Using lenses, such as cylindrical glass and plastics, this lens array gives a refractive-index distribution to a lens along with a cross section, and determines the optical path within a lens. Although the trouble of a lens array was hardly examined conventionally, flare light progressed the inside of a lens array, and the artificer found out bringing about image formation performance degradation. Such flare light brings about the skirt of the beam which carried out image formation, for example, and extends a beam. The breadth of the skirt of a beam causes the breadth of line breadth by the pattern by which it became a problem by regular patterns, such as a graphic, especially the dot continued, and reduces resolution. Moreover, the flare light which moves to other lenses from a certain lens in a lens array brings about a ghost picture. This ghost picture also appears notably in the figure which many dots followed.
[0003]
[Problem(s) to be Solved by the Invention] The technical problem of this invention intercepts the flare light in a lens array, and is to raise picture grace.
[0004]
[Elements of the Invention] While this invention split-face-izes the flank front face of each aforementioned lens and sets the average surface roughness to 0.5-5 micrometers in the picture equipment using the lens array which banded many cylindrical lenses together, and many carrier light emitting devices It is characterized by permeability preparing 20% or less of optical-absorption resin layer between each aforementioned lenses to the light of the wavelength more than the wavelength of the light used by the carrier light emitting device.
[0005] The surface roughness of the lens side considers as the average surface roughness measured with the surface roughness plan, processes the cylindrical lens before union by sandblasting, etching, especially etching, and gives surface roughness. If the suitable surface roughness for the flank front face of a lens is given, the flare light which progresses the inside of one lens can be scattered about with the irregularity on the front face of a flank, and the inside of a lens cannot be progressed, but it can prevent that flare light is emitted from the nose of cam of a lens. In less than 0.5 micrometers, since granularity is shorter than wavelength, the scattering effect of surface roughness of flare light is small, and it becomes remarkable [the prevention effect of flare light] by exceeding 0.5 micrometers.

For example, in the case of image formation equipments, such as a Light Emitting Diode head, the flare light which progresses the inside of one lens brings about the breadth of the skirt of a beam. Although it is not conspicuous in the print result (for example, print result which carried out the print using the photo conductor drum) which looked at this flare light to the isolated print dot with the naked eye, it is detectable if a beam measurement machine etc. is used. In a continuation print dot, the influence becomes remarkable by the lap of flare light, and, also with the naked eye, deterioration of print quality is sensed as a breadth of line breadth. On the other hand, if the surface average of roughness height of the lens side is set to 0.5 micrometers or more, the breadth of the line breadth in the naked eye to a continuation print dot will cease to be sensed. Even if it measures the intensity distribution of the beam of an isolated print dot with a beam measurement machine, the breadth of the skirt of a beam stops moreover, being conspicuous if the surface average of roughness height is set to 1 micrometers or more.

[0006] If the surface average of roughness height exceeds 5 micrometers, the stress concentration accompanying concavo-convex grant will occur, a crack arises on a lens in the part which stress concentration concentrated, or abnormalities arise in a refractive-index distribution, and an image formation performance falls. The crack generated in a lens is the process which lens intensity is reduced, and is cutting a lens and made into a lens array in a body, and brings about the shortage of intensity. When generating of stress concentration is prevented completely and a margin is taken into consideration, average surface roughness has desirable 3 micrometers or less. Then, the surface roughness of the lens side sets 0.5-5 micrometers to 1-3 micrometers more preferably.

[0007] Between lenses, permeability prepares 20% or less of optical-absorption resin layer to the light of the wavelength more than the light wave length who uses, for example, a lens is covered with such an optical-absorption resin layer. Before union of a lens, such an optical-absorption resin layer applies to the lens side beforehand, and defines permeability to the applied optical-absorption resin layer. In addition, in not applying an optical-absorption resin layer to a lens front face but filling up with an optical-absorption resin layer the crevice between the lens which banded together, and a lens, it defines permeability to the optical-absorption resin layer of this thickness as a thing with one half of the optical-absorption resin layers of thickness of the average crevice between a lens and a lens. When using Light Emitting Diode with a wavelength of 685nm, using the permeability to the light of the wavelength more than the wavelength used with picture equipment, in consideration of the wavelength distribution of 685nm**30nm, the permeability to the wavelength of 660nm or more by the side of the short wavelength of a wavelength distribution defines permeability. here -- more than [wavelength] -- ** -- carrying out -- general -- a long wave -- a merit side (near infrared region) -- the absorbancy index of a pigment etc. -- small -- becoming -- the long wave of luminescence wavelength -- it is because it is easy to produce flare light in a merit side

[0008] Such an optical-absorption resin layer is applied to an individual lens by about 10-micrometer thickness, for example, mixture (resin [, such as silicone resin, an epoxy resin, and acrylic resin,] 95 - 60wt% and pigment [, such as carbon black, titanium-carbon, and an iron oxide,] 5 - 40wt%) etc. is used for it. If permeability becomes 20% at 10-micrometer thickness at pigment concentration 5wt% and 40wt% is exceeded, uniform distribution of the pigment to the inside of a resin will become difficult, and will bring about the increase in local permeability. More desirable composition makes the whole quantity of a resin and a pigment 100wt(s)%, it is pigment 10 - 30wt%, and permeability becomes 4% or less in this range.

[0009] In such a lens array, many lenses are related to the image formation of one dot. And by regular patterns, such as a graphic, the flare light which moves between a lens and lenses brings about a ghost picture, and, also with the naked eye, comes to be sensed as deterioration of print quality. When the optical-absorption resin layer of 20% or less of permeability was prepared; it becomes impossible for the ghost picture to also have distinguished the print of a regular pattern with the naked eye, and it

became impossible for a beam measurement machine to also detect a ghost picture [as opposed to the print of a regular pattern in permeability] in 4% or less in an experiment of an artificer.

[0010] The picture equipment which used the lens array and carrier light emitting devices other than the Light Emitting Diode head shown in the example, such as a liquid crystal shutter array head, and a contact type image sensor, a PLZT head, is used for picture equipment.

[0011]

[Function of the Invention] The lens side of a lens array is split-face-ized in this invention. By split-face-ization, the flare light which progresses the inside of one lens will be reflected irregularly with the irregularity of the lens side, and will not advance the inside of a lens. And flare light is absorbed while repeating dispersion within a lens, and it disappears. Next, in order to absorb the flare light which moves between a lens and lenses, a black optical-absorption resin layer is prepared to the wavelength to be used. For this reason, the flare light it is supposed that is changed on other lenses from a certain lens is absorbed in an optical-absorption resin layer, and disappears. For these reasons, the flare light which moves between the adjoining lenses is also removed, and picture grace of flare light which progresses the inside of one lens improves.

[0012]

[Example] The first example is shown in drawing 1 - drawing 3 . In drawing 1 , 2 is a lens array and 4 is cylindrical lenses, such as glass and plastics. 6 is a side plate using the black resin etc., and 8 is a frame using the same black resin etc. 10 is a transparent resin layer by the side of an incident light, and 12 is a transparent resin layer by the side of outgoing radiation light, and it is not necessary to give priority to and form the transparent resin layer 10 by the side of an incident light, and to form the transparent resin layer 12 by the side of outgoing radiation light. Moreover, the resin layers 10 and 12 are made to distribute a pigment etc., and you may make it make light absorb partially.

[0013] The lens array 2 is what transformed the self-focusing lens array, for example, it bands together, and fixes by the side plate, and it cuts and forms a cylindrical long picture-like lens. Under the influence of [at the time of cutting], it is ruined and dispersion of light produces it. In order to prevent dispersion of the light by the end face of a lens 4, the end face of the both sides of a lens 4 is covered with the transparent resin layers 10 and 12. In the transparent resin layers 10 and 12, using resins, such as epoxy, an acrylic, and polyester, since a refractive index is close to a lens 4, dispersion of the light in the end face of a lens 4 can be prevented. Since the lens 4 and the refractive index covered the end face with the analogous transparent resin layers 10 and 12, this is because the dry area of the end face of a lens 4 is not sensed for light. Since the lens effect arises that the thickness of the transparent resin layers 10 and 12 is uneven and an optical path changes from a straight line, frames 8 and 8 are formed, the transparent resin layers 10 and 12 are slushed, and the thickness is made uniform.

[0014] The individual lens 4 is shown in drawing 2 . A lens 4 has the distribution of a refractive index along with a cross section, and light advances, being led by refractive-index distribution. A diameter is about 1.1mm, using glass, plastics, etc. in the quality of the material of a lens 4. The flank front face of a lens 4 is split-face-ized like drawing 2 , and the surface roughness sets 0.5-5 micrometers to 1-3 micrometers more preferably as average surface roughness measured with the surface roughness plan. Etching is used for split-face-ization. The split-face-ized front face is shown as a surface layer 16.

[0015] A lens 4 is covered with the optical-absorption resin layer 18 as shown in drawing 3 . A black pigment is used for a pigment by near infrared regions, such as carbon black, titanium-carbon, and a black iron oxide, at the resinous principle of the resin layer 18 using silicone resin. a pigment addition -- the total weight of a resin 18 -- 100wt(s)% -- carrying out -- pigment 5 - 40wt% -- you may be 10 - 30wt% more preferably Less than [5wt%], permeability exceeds 20% (in the case of 10 micrometers of thickness), and cannot absorb enough the flare light which moves to other lenses 4 from a lens 4.

On the other hand, if a pigment exceeds 40wt(s)%, since uniform distribution becomes difficult, an application will become difficult, and a portion with high permeability will arise locally. If a pigment content is made into 10 - 30wt%, permeability becomes less than 4% and can absorb flare light nearly completely. Although drawing 3 showed that the crevice between a lens 4 and 4 was filled up with the optical-absorption resin layer 18, it is desirable for the optical-absorption resin layer 18 to cover a lens 4 by about 10-micrometer thickness, for example before union, and to band together by the same black resin. If it does in this way, the maximum contiguity section of lenses 4 and 4 cannot contact directly, either, but can form the optical-absorption resin layer 18 between them, and lenses 4 and 4 can absorb light for it. Moreover, permeability is the same thickness as applying to a lens 4, is applied on a glass plate and measured.

[0016] It returns to drawing 1 and other portions of picture equipment are explained. 20 is cylinder-head covers, such as plastics, and it is desirable to intercept the stray light using the black resin in carrying out the black coat of the inside. 22 is the salient for positioning and, as for substrates, such as a ceramic to which 24 carried out the glass glaze of glass or the front face, and 26, an LED array and 28 are the emitter. 30 is a transparent resin layer for carrying out the mould of LED array 26, and 32 is a frame stop flowing for preventing that the transparent resin layer 30 flows out. By using a frame 32 stop flowing, the front face of the transparent resin layer 30 is made into a plane, and it prevents that an optical path is bent according to the front face of the transparent resin layer 30 not being smooth. Other portions of a Light Emitting Diode head are common knowledge, and omit explanation.

[0017] The various modifications over the lens array 2 are shown in drawing 4 - drawing 6 . In the lens array 42 of drawing 4 , a side plate 44 is used also [frame]. However, since this will band without a side plate 44 together and will cut a lens 4, compared with the lens array 2 of drawing 1 , manufacture is difficult for it. 46 and 48 are new transparent resin layers.

[0018] In the lens array 52 of drawing 5 , a cylinder-head cover 20 is used also [frame], and the transparent resin layers 10 and 12 are formed. In this modification, the transparent resin layers 10 and 12 are slushed and stiffened by using a cylinder-head cover 20 and a fixture as a mold using a fixture suitable as a mold of the transparent resin layers 10 and 12.

[0019] In the lens array 62 of drawing 6 , the micro-lens arrays 64 and 66 are formed in the upper and lower sides of a lens 4. 64 is a micro-lens array by the side of an incident light, and 66 is a micro-lens array by the side of outgoing radiation light. The micro-lens arrays 64 and 66 slush and cast a transparent resin using a frame 8 and the mold according to the shape of surface type of the micro-lens arrays 64 and 66. These micro lenses are compound eye lenses, and use a lens with a path smaller than each lens 4. The micro-lens arrays 64 and 66 consider as the array of a micro convex lens, and as shown in drawing, they prepare the portion of a convex in the outside of a lens 4.

[0020] It is difficult to get to know the thickness itself in the example, although the thickness of the transparent resin layer 10 and 12 grades is uniform. This is for dispersion of thickness of frame 8 grade. Moreover, it is also difficult to get to know the thickness of the transparent resin layer 30. Then, after the assembly of picture equipment, using a photo conductor drum, a CCD camera, etc. which are not illustrated, the optimal image formation position is explored and the optimal attaching position to the photo conductor drum of a cylinder-head cover 20 is memorized. The attachment screw which is not illustrated is formed in a cylinder-head cover 20, and it enables it to tune an interval with a photo conductor drum etc. finely with this screw to it. And based on the optimal attaching position measured at the time of assembly, an attachment screw is tuned finely, and a fine-tuning screw adjusts an interval so that the optical path from the emitter 28 to the center of the lens array 2 and the optical path from the center of the lens array 2 to a photo conductor drum may be in agreement. If it does in this way, even if it changes an optical path by change of the thickness of the transparent resin layers

10, 12, and 30, the optimal image formation performance can be obtained.

[0021] Drawing 7 - drawing 10 show an operation of an example. The flare absorption of light is shown in drawing 7 . The cylindrical lens 4 has the distribution of a refractive index, and the light included in the range of the angular aperture of a lens 4 progresses like the solid line of drawing, and is not given to the lens side. On the other hand, it is light with a bigger incident angle than angular aperture, flare light (dashed line of drawing) reaches the surface layer 16 of a lens 4, and since the irregularity which is equal to the wavelength of light is shown in a surface layer 16, they is scattered about. The chain line of drawing shows the beam of the scattered light. In order that flare light may repeat dispersion to progress the inside of a lens 4, flare light cannot advance the inside of a lens 4, but the flare light by which outgoing radiation is carried out from the nose of cam of a lens 4 serves as **** part. For example, by about [1/several], the flare light ahead scattered about by one dispersion is decreased for every dispersion, and flare light is decreased to several [1/]. And if dispersion is repeated about several times, flare light will become very small and will be set to about 0 as an output light from a lens 4.

[0022] Flare light will be absorbed by the optical-absorption resin layer 18 in the meantime, if light moves to other lenses 4 from a certain lens 4 and flare light arises. For the optical-absorption resin layer 18 is 20% or less and permeability's moving from it to other lenses, total permeability becomes 4% or less (the layer of 20% or less of permeability is passed twice).

[0023] The artificer examined the grade of the granularity of a surface layer 16, and the effect of the permeability of the resin layer 18 using LED array 26 with a wavelength of 685nm. To a lens 4, there are two kinds, the flare light which progresses the inside of one lens, and the flare light which moves between lenses, and the flare light which progresses the inside of one lens brings about the breadth of the line breadth of a picture. In an isolated print dot, this effect is small, is sensed as a breadth of line breadth by regular patterns, such as a graphic, and is conspicuous and shows up especially to a continuation print dot. it is generated with dispersion in a lens 4, dispersion of an emitter 28, etc., flare light is boiled to that extent, is irregular, and since there is dispersion also in how depending on which line breadth spreads, it is sensed as concentration unevenness The concentration unevenness at the time of carrying out a print using an a-Si photo conductor drum is no longer sensed to a regular continuation print dot with the naked eye, and even if it used a beam measurement machine, the breadth of the skirt of a beam stopped being conspicuous in 1 micrometers or more, if average surface roughness of the surface layer 16 of a lens 4 is set to 0.5 micrometers or more here.

[0024] The lens array 2 is what banded the lens 4 together for example, in two trains, and about seven lenses 4 are related to the image formation of 1 dot. A lens 4 and the flare light which moves between four bring about a ghost picture, and this appears into the portion of a continuation print dot strongly especially by the regular pattern. When a ghost picture will not be sensed [as opposed to / the print result of the continuation print dot of a graphic pattern / with a naked eye] if permeability with a wavelength of 660nm covers a lens 4 with the optical-absorption resin layer 18 which is about 20%, but permeability was made 4% or less, it became impossible for a beam measurement machine to also detect a ghost picture (if for pigment concentration to be carried out more than 10wt%).

[0025] In addition, by the result at the time of removing the transparent resin layers 10 and 12 and the black frame 8, these can make influence of flare light still smaller except for the cause of flare light, such as dispersion by the end face of a lens 4, itself, if these things are used.

[0026] It moves to drawing 8 - drawing 10 , and there is a dry area in the end face of a lens 4 under the influence of [at the time of cutting]. Although light will be scattered about if a dry area is left, it covers with the transparent resin layers 10 and 12, and the influence of a dry area is prevented using the refractive index of the transparent resin layers 10 and 12 and a lens 4 being near.

[0027] As shown in drawing 8 , since the refractive index of the transparent resin layer 10 is higher

than surrounding air, if the light from an emitter 28 goes into the transparent resin layer 10, a parallel ray will be approached and a light beam will converge. For this reason, image formation also of the incident light in the wide angle which originally cannot be used with a lens 4 can be carried out with a lens 4, and it can form a brighter picture. Moreover, if an incident light is brought close to a collimated beam in advance in the transparent resin layer 10, the burden of a lens 4 can mitigate and an image formation performance can be raised. Incidence of the light which furthermore causes a ghost picture is carried out to the frame 8 of a black resin, and it is absorbed. In addition, the meaning that it is black here means that it is black to the light of the wavelength more than the wavelength of the light to be used, and in the case of an example, if it is black on the wavelength more than the luminescence wavelength of LED array 26, it is good. Moreover, if the transparent resin layer 10 is made to distribute black pigment etc., since the travel within the transparent resin layer 10 is long, the light which carried out incidence to the transparent resin layer 10 by the wide angle can be absorbed preferentially, and flare light can be removed further.

[0028] An example covers LED array 26 in the transparent resin layer 30, in order to protect LED array 26 and to strengthen the incident light to the lens array 2. It is because a part of output light reflects by the interface with air and it is shut up in an emitter 28, since this has the large difference of the refractive index of an emitter 28 and air. Then, the resin layer 30 of the middle refractive index of an emitter 28 and air is made to intervene, and the locked-in effect of the light to an emitter 28 is prevented. Next, a frame 32 is formed stop flowing on both sides of the transparent resin layer 30, the transparent resin layer 30 is formed using the resin of low viscosity, and the front face of the transparent resin layer 30 is made into a plane. The light of 30 transparent resin layer from an emitter 28 spreads like the beam of the chain line at the lower right of drawing 8 , when there is nothing. On the other hand, if the transparent resin layer 30 is formed, since the refractive index is larger than air, a beam can be extracted like the dashed line of drawing 8 , and a directive high light beam can be taken out. Moreover, when the transparent resin layer 30 is formed, it means that only the value of the product of a difference with the refractive index of the refractive index of the transparent resin layer 30 and air and the thickness of the transparent resin layer 30 had brought LED array 26 close to the lens array 2 side optically. Consequently, the breadth of the light beam in the middle can be prevented and the incident light to the lens array 2 can be strengthened.

[0029] The light which carries out outgoing radiation to the photo conductor drum side which is not illustrated from the lens array 2 passes along the transparent resin layer 12. And the refractive index of the transparent resin layer 12 cancels the influence of the dry area of the end face by the side of the outgoing radiation of a lens 4 using being close to the refractive index of a lens 4.

[0030] Drawing 9 explains the cure to dispersion between a lens 4 and 4. There is dispersion in an image formation performance in a lens 4, and the influence of dispersion increases, so that there are many numbers of the lens 4 related to image formation. Since the refractive index of the transparent resin layer 10 is larger than the refractive index of air, if the light from an emitter 28 goes into the transparent resin layer 10, it will approach a parallel ray, and the number of the lens 4 related to image formation decreases like a solid line to drawing 9 . Consequently, the influence of a lens 4 and property dispersion between four becomes small.

[0031] An operation of the micro-lens arrays 64 and 66 is shown in drawing 10 . Spreading from an emitter 28, it considers as the array of a convex lens, and the micro-lens arrays 64 and 66 bring the light which carries out incidence close to a parallel ray, by the micro-lens array 66 by the side of outgoing radiation, they turn outgoing radiation light to a focus, and extract it further at the micro-lens array 64 by the side of incidence. Thus, it is an operation of the micro-lens arrays 64 and 66 to turn an optical path to a center and to bend it. If it does in this way, the light from an emitter 28 is brought close to a parallel ray by the micro-lens array 64, incidence of more light can be carried out into the

angular aperture of a lens 4, and a brighter picture can be made, and an incident ray can be brought close to a parallel ray, and an image formation performance can be raised. The number of the lens 4 related to image formation can be decreased similarly, and influence of property dispersion can be made small. In the micro-lens array 66 by the side of outgoing radiation light, the optical path of outgoing radiation light is turned to a focus, and is bent, and an image formation performance is raised further.

[0032] The micro-lens arrays 64 and 66 pour in and form a transparent resin using a frame 8 and the fixture which is not illustrated. And the irregularity corresponding to the micro lens is formed with the fixture which is not illustrated. For this reason, thickness of the micro-lens arrays 64 and 66 can be made uniform, and it can form easily.

[0033] As a cure to flare light, 0.5-5-micrometer surface roughness was given to the lens flank front face, and the black optical-absorption resin layer covered in the example to Light Emitting Diode light. Moreover, although the transparent resin layers 10 and 12 and the black frame 8 grade were shown in addition to this, neither the transparent resin layers 10 and 12 nor frame 8 grade needs to prepare.

[0034]

[Effect of the Invention] In this invention, the flare light in a lens array can be removed and picture grace can be raised.

[Translation done.]

* NOTICES *

TECHNICAL FIELD

[Application of the Invention] This invention relates to the picture equipment which used a carrier light emitting device and lens arrays, such as a Light Emitting Diode head, a contact type image sensor and a liquid crystal shutter array head, and a PLZT head. Especially this invention relates to improvement of the lens array to be used.

[Translation done.]

* NOTICES *

PRIOR ART

[Description of the Prior Art] With picture equipments, such as a Light Emitting Diode head and a contact type image sensor, lens arrays, such as a self-focusing lens array, are used. Using lenses, such as cylindrical glass and plastics, this lens array gives a refractive-index distribution to a lens along with a cross section, and determines the optical path within a lens. Although the trouble of a lens array was hardly examined conventionally, flare light progressed the inside of a lens array, and the artificer found out bringing about image formation performance degradation. Such flare light brings about the skirt of the beam which carried out image formation, for example, and extends a beam. The breadth of the skirt of a beam causes the breadth of line breadth by the pattern by which it became a problem by regular patterns, such as a graphic, especially the dot continued, and reduces resolution. Moreover, the flare light which moves to other lenses from a certain lens in a lens array brings about a ghost picture. This ghost picture also appears notably in the figure which many dots followed.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] In this invention, the flare light in a lens array can be removed and picture grace can be raised.

[Translation done.]

* NOTICES *

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] The technical problem of this invention intercepts the flare light in a lens array, and is to raise picture grace.
[0004]
[Elements of the Invention] While this invention split-face-izes the flank front face of each aforementioned lens and sets the average surface roughness to 0.5-5 micrometers in the picture equipment using the lens array which banded many cylindrical lenses together, and many carrier light emitting devices It is characterized by permeability preparing 20% or less of optical-absorption resin layer between each aforementioned lenses to the light of the wavelength more than the wavelength of the light used by the carrier light emitting device.
[0005] The surface roughness of the lens side considers as the average surface roughness measured with the surface roughness plan, processes the cylindrical lens before union by sandblasting, etching, especially etching, and gives surface roughness. If the suitable surface roughness for the flank front face of a lens is given, the flare light which progresses the inside of one lens can be scattered about with the irregularity on the front face of a flank, and the inside of a lens cannot be progressed, but it can prevent that flare light is emitted from the nose of cam of a lens. In less than 0.5 micrometers, since granularity is shorter than wavelength, the scattering effect of surface roughness of flare light is small, and it becomes remarkable [the prevention effect of flare light] by exceeding 0.5 micrometers. For example, in the case of image formation equipments, such as a Light Emitting Diode head, the flare light which progresses the inside of one lens brings about the breadth of the skirt of a beam. Although it is not conspicuous in the print result (for example, print result which carried out the print using the photo conductor drum) which looked at this flare light to the isolated print dot with the naked eye, it is detectable if a beam measurement machine etc. is used. In a continuation print dot, the influence becomes remarkable by the lap of flare light, and, also with the naked eye, deterioration of print quality is sensed as a breadth of line breadth. On the other hand, if the surface average of roughness height of the lens side is set to 0.5 micrometers or more, the breadth of the line breadth in the naked eye to a continuation print dot will cease to be sensed. Even if it measures the intensity distribution of the beam of an isolated print dot with a beam measurement machine, the breadth of the skirt of a beam stops moreover, being conspicuous if the surface average of roughness height is set to 1 micrometers or more.
[0006] If the surface average of roughness height exceeds 5 micrometers, the stress concentration accompanying concavo-convex grant will occur, a crack arises on a lens in the part which stress concentration concentrated, or abnormalities arise in a refractive-index distribution, and an image formation performance falls. The crack generated in a lens is the process which lens intensity is reduced, and is cutting a lens and made into a lens array in a body, and brings about the shortage of intensity. When generating of stress concentration is prevented completely and a margin is taken into consideration, average surface roughness has desirable 3 micrometers or less. Then, the surface

roughness of the lens side sets 0.5-5 micrometers to 1-3 micrometers more preferably.

[0007] Between lenses, permeability prepares 20% or less of optical-absorption resin layer to the light of the wavelength more than the light wave length who uses, for example, a lens is covered with such an optical-absorption resin layer. Before union of a lens, such an optical-absorption resin layer applies to the lens side beforehand, and defines permeability to the applied optical-absorption resin layer. In addition, in not applying an optical-absorption resin layer to a lens front face but filling up with an optical-absorption resin layer the crevice between the lens which banded together, and a lens, it defines permeability to the optical-absorption resin layer of this thickness as a thing with one half of the optical-absorption resin layers of thickness of the average crevice between a lens and a lens. When using Light Emitting Diode with a wavelength of 685nm, using the permeability to the light of the wavelength more than the wavelength used with picture equipment, in consideration of the wavelength distribution of 685nm**30nm, the permeability to the wavelength of 660nm or more by the side of the short wavelength of a wavelength distribution defines permeability. here -- more than [wavelength] -- ** -- carrying out -- general -- a long wave -- a merit side (near infrared region) -- the absorbancy index of a pigment etc. -- small -- becoming -- the long wave of luminescence wavelength -- it is because it is easy to produce flare light in a merit side

[0008] Such an optical-absorption resin layer is applied to an individual lens by about 10-micrometer thickness, for example, mixture (resin [, such as silicone resin, an epoxy resin, and acrylic resin,] 95 - 60wt% and pigment [, such as carbon black, titanium-carbon, and an iron oxide,] 5 - 40wt%) etc. is used for it. If permeability becomes 20% at 10-micrometer thickness at pigment concentration 5wt% and 40wt% is exceeded, uniform distribution of the pigment to the inside of a resin will become difficult, and will bring about the increase in local permeability. More desirable composition makes the whole quantity of a resin and a pigment 100wt(s)%, it is pigment 10 - 30wt%, and permeability becomes 4% or less in this range.

[0009] In such a lens array, many lenses are related to the image formation of one dot. And by regular patterns, such as a graphic, the flare light which moves between a lens and lenses brings about a ghost picture, and, also with the naked eye, comes to be sensed as deterioration of print quality. When the optical-absorption resin layer of 20% or less of permeability was prepared, it becomes impossible for the ghost picture to also have distinguished the print of a regular pattern with the naked eye, and it became impossible for a beam measurement machine to also detect a ghost picture [as opposed to the print of a regular pattern in permeability] in 4% or less in an experiment of an artificer.

[0010] The picture equipment which used the lens array and carrier light emitting devices other than the Light Emitting Diode head shown in the example, such as a liquid crystal shutter array head, and a contact type image sensor, a PLZT head, is used for picture equipment.

[Translation done.]

OPERATION

[Function of the Invention] The lens side of a lens array is split-face-ized in this invention. By split-face-ization, the flare light which progresses the inside of one lens will be reflected irregularly with the irregularity of the lens side, and will not advance the inside of a lens. And flare light is absorbed while repeating dispersion within a lens, and it disappears. Next, in order to absorb the flare light which moves between a lens and lenses, a black optical-absorption resin layer is prepared to the wavelength to be used. For this reason, the flare light it is supposed that is changed on other lenses from a certain lens is absorbed in an optical-absorption resin layer, and disappears. For these reasons, the flare light which moves between the adjoining lenses is also removed, and picture grace of flare light which progresses the inside of one lens improves.

[Translation done.]

* NOTICES *

EXAMPLE

[Example] The first example is shown in drawing 1 - drawing 3 . In drawing 1 , 2 is a lens array and 4 is cylindrical lenses, such as glass and plastics. 6 is a side plate using the black resin etc., and 8 is a frame using the same black resin etc. 10 is a transparent resin layer by the side of an incident light, and 12 is a transparent resin layer by the side of outgoing radiation light, and it is not necessary to give priority to and form the transparent resin layer 10 by the side of an incident light, and to form the transparent resin layer 12 by the side of outgoing radiation light. Moreover, the resin layers 10 and 12 are made to distribute a pigment etc., and you may make it make light absorb partially.
[0013] The lens array 2 is what transformed the self-focusing lens array, for example, it bands together, and fixes by the side plate, and it cuts and forms a cylindrical long picture-like lens. Under the influence of [at the time of cutting], it is ruined and dispersion of light produces it. In order to prevent dispersion of the light by the end face of a lens 4, the end face of the both sides of a lens 4 is covered with the transparent resin layers 10 and 12. In the transparent resin layers 10 and 12, using resins, such as epoxy, an acrylic, and polyester, since a refractive index is close to a lens 4, dispersion of the light in the end face of a lens 4 can be prevented. Since the lens 4 and the refractive index covered the end face with the analogous transparent resin layers 10 and 12, this is because the dry area of the end face of a lens 4 is not sensed for light. Since the lens effect arises that the thickness of the transparent resin layers 10 and 12 is uneven and an optical path changes from a straight line, frames 8 and 8 are formed, the transparent resin layers 10 and 12 are slushed, and the thickness is made uniform.
[0014] The individual lens 4 is shown in drawing 2 . A lens 4 has the distribution of a refractive index along with a cross section, and light advances, being led by refractive-index distribution. A diameter is about 1.1mm, using glass, plastics, etc. in the quality of the material of a lens 4. The flank front face of a lens 4 is split-face-ized like drawing 2 , and the surface roughness sets 0.5-5 micrometers to 1-3 micrometers more preferably as average surface roughness measured with the surface roughness plan. Etching is used for split-face-ization. The split-face-ized front face is shown as a surface layer 16.
[0015] A lens 4 is covered with the optical-absorption resin layer 18 as shown in drawing 3 . A black pigment is used for a pigment by near infrared regions, such as carbon black, titanium-carbon, and a black iron oxide, at the resinous principle of the resin layer 18 using silicone resin. a pigment addition -- the total weight of a resin 18 -- 100wt(s)% -- carrying out -- pigment 5 - 40wt% -- you may be 10 - 30wt% more preferably Less than [5wt%], permeability exceeds 20% (in the case of 10 micrometers of thickness), and cannot absorb enough the flare light which moves to other lenses 4 from a lens 4. On the other hand, if a pigment exceeds 40wt(s)%, since uniform distribution becomes difficult, an application will become difficult, and a portion with high permeability will arise locally. If a pigment content is made into 10 - 30wt%, permeability becomes less than 4% and can absorb flare light nearly completely. Although drawing 3 showed that the crevice between a lens 4 and 4 was filled up with the

optical-absorption resin layer 18, it is desirable for the optical-absorption resin layer 18 to cover a lens 4 by about 10-micrometer thickness, for example before union, and to band together by the same black resin. If it does in this way, the maximum contiguity section of lenses 4 and 4 cannot contact directly, either, but can form the optical-absorption resin layer 18 between them, and lenses 4 and 4 can absorb light for it. Moreover, permeability is the same thickness as applying to a lens 4, is applied on a glass plate and measured.

[0016] It returns to drawing 1 and other portions of picture equipment are explained. 20 is cylinder-head covers, such as plastics, and it is desirable to intercept the stray light using the black resin in carrying out the black coat of the inside. 22 is the salient for positioning and, as for substrates, such as a ceramic to which 24 carried out the glass glaze of glass or the front face, and 26, an LED array and 28 are the emitter. 30 is a transparent resin layer for carrying out the mould of LED array 26, and 32 is a frame stop flowing for preventing that the transparent resin layer 30 flows out. By using a frame 32 stop flowing, the front face of the transparent resin layer 30 is made into a plane, and it prevents that an optical path is bent according to the front face of the transparent resin layer 30 not being smooth. Other portions of a Light Emitting Diode head are common knowledge, and omit explanation.

[0017] The various modifications over the lens array 2 are shown in drawing 4 - drawing 6 . In the lens array 42 of drawing 4 , a side plate 44 is used also [frame]. However, since this will band without a side plate 44 together and will cut a lens 4, compared with the lens array 2 of drawing 1 , manufacture is difficult for it. 46 and 48 are new transparent resin layers.

[0018] In the lens array 52 of drawing 5 , a cylinder-head cover 20 is used also [frame], and the transparent resin layers 10 and 12 are formed. In this modification, the transparent resin layers 10 and 12 are slushed and stiffened by using a cylinder-head cover 20 and a fixture as a mold using a fixture suitable as a mold of the transparent resin layers 10 and 12.

[0019] In the lens array 62 of drawing 6 , the micro-lens arrays 64 and 66 are formed in the upper and lower sides of a lens 4. 64 is a micro-lens array by the side of an incident light, and 66 is a micro-lens array by the side of outgoing radiation light. The micro-lens arrays 64 and 66 slush and cast a transparent resin using a frame 8 and the mold according to the shape of surface type of the micro-lens arrays 64 and 66. These micro lenses are compound eye lenses, and use a lens with a path smaller than each lens 4. The micro-lens arrays 64 and 66 consider as the array of a micro convex lens, and as shown in drawing, they prepare the portion of a convex in the outside of a lens 4.

[0020] It is difficult to get to know the thickness itself in the example, although the thickness of the transparent resin layer 10 and 12 grades is uniform. This is for dispersion of thickness of frame 8 grade. Moreover, it is also difficult to get to know the thickness of the transparent resin layer 30. Then, after the assembly of picture equipment, using a photo conductor drum, a CCD camera, etc. which are not illustrated, the optimal image formation position is explored and the optimal attaching position to the photo conductor drum of a cylinder-head cover 20 is memorized. The attachment screw which is not illustrated is formed in a cylinder-head cover 20, and it enables it to tune an interval with a photo conductor drum etc. finely with this screw to it. And based on the optimal attaching position measured at the time of assembly, an attachment screw is tuned finely, and a fine-tuning screw adjusts an interval so that the optical path from the emitter 28 to the center of the lens array 2 and the optical path from the center of the lens array 2 to a photo conductor drum may be in agreement. If it does in this way, even if it changes an optical path by change of the thickness of the transparent resin layers 10, 12, and 30, the optimal image formation performance can be obtained.

[0021] Drawing 7 - drawing 10 show an operation of an example. The flare absorption of light is shown in drawing 7 . The cylindrical lens 4 has the distribution of a refractive index, and the light included in the range of the angular aperture of a lens 4 progresses like the solid line of drawing, and

is not given to the lens side. On the other hand, it is light with a bigger incident angle than angular aperture, flare light (dashed line of drawing) reaches the surface layer 16 of a lens 4, and since the irregularity which is equal to the wavelength of light is shown in a surface layer 16, they is scattered about. The chain line of drawing shows the beam of the scattered light. In order that flare light may repeat dispersion to progress the inside of a lens 4, flare light cannot advance the inside of a lens 4, but the flare light by which outgoing radiation is carried out from the nose of cam of a lens 4 serves as **** part. For example, by about [1/several], the flare light ahead scattered about by one dispersion is decreased for every dispersion, and flare light is decreased to several [1/]. And if dispersion is repeated about several times, flare light will become very small and will be set to about 0 as an output light from a lens 4.

[0022] Flare light will be absorbed by the optical-absorption resin layer 18 in the meantime, if light moves to other lenses 4 from a certain lens 4 and flare light arises. For the optical-absorption resin layer 18 is 20% or less and permeability's moving from it to other lenses, total permeability becomes 4% or less (the layer of 20% or less of permeability is passed twice).

[0023] The artificer examined the grade of the granularity of a surface layer 16, and the effect of the permeability of the resin layer 18 using LED array 26 with a wavelength of 685nm. To a lens 4, there are two kinds, the flare light which progresses the inside of one lens, and the flare light which moves between lenses, and the flare light which progresses the inside of one lens brings about the breadth of the line breadth of a picture. In an isolated print dot, this effect is small, is sensed as a breadth of line breadth by regular patterns, such as a graphic, and is conspicuous and shows up especially to a continuation print dot. it is generated with dispersion in a lens 4, dispersion of an emitter 28, etc., flare light is boiled to that extent, is irregular, and since there is dispersion also in how depending on which line breadth spreads, it is sensed as concentration unevenness The concentration unevenness at the time of carrying out a print using an a-Si photo conductor drum is no longer sensed to a regular continuation print dot with the naked eye, and even if it used a beam measurement machine, the breadth of the skirt of a beam stopped being conspicuous in 1 micrometers or more, if average surface roughness of the surface layer 16 of a lens 4 is set to 0.5 micrometers or more here.

[0024] The lens array 2 is what banded the lens 4 together for example, in two trains, and about seven lenses 4 are related to the image formation of 1 dot. A lens 4 and the flare light which moves between four bring about a ghost picture, and this appears into the portion of a continuation print dot strongly especially by the regular pattern. When a ghost picture will not be sensed [as opposed to / the print result of the continuation print dot of a graphic pattern / with a naked eye] if permeability with a wavelength of 660nm covers a lens 4 with the optical-absorption resin layer 18 which is about 20%, but permeability was made 4% or less, it became impossible for a beam measurement machine to also detect a ghost picture (if for pigment concentration to be carried out more than 10wt%).

[0025] In addition, by the result at the time of removing the transparent resin layers 10 and 12 and the black frame 8, these can make influence of flare light still smaller except for the cause of flare light, such as dispersion by the end face of a lens 4, itself, if these things are used.

[0026] It moves to drawing 8 - drawing 10 , and there is a dry area in the end face of a lens 4 under the influence of [at the time of cutting]. Although light will be scattered about if a dry area is left, it covers with the transparent resin layers 10 and 12, and the influence of a dry area is prevented using the refractive index of the transparent resin layers 10 and 12 and a lens 4 being near.

[0027] As shown in drawing 8 , since the refractive index of the transparent resin layer 10 is higher than surrounding air, if the light from an emitter 28 goes into the transparent resin layer 10, a parallel ray will be approached and a light beam will converge. For this reason, image formation also of the incident light in the wide angle which originally cannot be used with a lens 4 can be carried out with a lens 4, and it can form a brighter picture. Moreover, if an incident light is brought close to a

collimated beam in advance in the transparent resin layer 10, the burden of a lens 4 can mitigate and an image formation performance can be raised. Incidence of the light which furthermore causes a ghost picture is carried out to the frame 8 of a black resin, and it is absorbed. In addition, the meaning that it is black here means that it is black to the light of the wavelength more than the wavelength of the light to be used, and in the case of an example, if it is black on the wavelength more than the luminescence wavelength of LED array 26, it is good. Moreover, if the transparent resin layer 10 is made to distribute black pigment etc., since the travel within the transparent resin layer 10 is long, the light which carried out incidence to the transparent resin layer 10 by the wide angle can be absorbed preferentially, and flare light can be removed further.

[0028] An example covers LED array 26 in the transparent resin layer 30, in order to protect LED array 26 and to strengthen the incident light to the lens array 2. It is because a part of output light reflects by the interface with air and it is shut up in an emitter 28, since this has the large difference of the refractive index of an emitter 28 and air. Then, the resin layer 30 of the middle refractive index of an emitter 28 and air is made to intervene, and the locked-in effect of the light to an emitter 28 is prevented. Next, a frame 32 is formed stop flowing on both sides of the transparent resin layer 30, the transparent resin layer 30 is formed using the resin of low viscosity, and the front face of the transparent resin layer 30 is made into a plane. The light of 30 transparent resin layer from an emitter 28 spreads like the beam of the chain line at the lower right of drawing 8 , when there is nothing. On the other hand, if the transparent resin layer 30 is formed, since the refractive index is larger than air, a beam can be extracted like the dashed line of drawing 8 , and a directive high light beam can be taken out. Moreover, when the transparent resin layer 30 is formed, it means that only the value of the product of a difference with the refractive index of the refractive index of the transparent resin layer 30 and air and the thickness of the transparent resin layer 30 had brought LED array 26 close to the lens array 2 side optically. Consequently, the breadth of the light beam in the middle can be prevented and the incident light to the lens array 2 can be strengthened.

[0029] The light which carries out outgoing radiation to the photo conductor drum side which is not illustrated from the lens array 2 passes along the transparent resin layer 12. And the refractive index of the transparent resin layer 12 cancels the influence of the dry area of the end face by the side of the outgoing radiation of a lens 4 using being close to the refractive index of a lens 4.

[0030] Drawing 9 explains the cure to dispersion between a lens 4 and 4. There is dispersion in an image formation performance in a lens 4, and the influence of dispersion increases, so that there are many numbers of the lens 4 related to image formation. Since the refractive index of the transparent resin layer 10 is larger than the refractive index of air, if the light from an emitter 28 goes into the transparent resin layer 10, it will approach a parallel ray, and the number of the lens 4 related to image formation decreases like a solid line to drawing 9 . Consequently, the influence of a lens 4 and property dispersion between four becomes small.

[0031] An operation of the micro-lens arrays 64 and 66 is shown in drawing 10 . Spreading from an emitter 28, it considers as the array of a convex lens, and the micro-lens arrays 64 and 66 bring the light which carries out incidence close to a parallel ray, by the micro-lens array 66 by the side of outgoing radiation, they turn outgoing radiation light to a focus, and extract it further at the micro-lens array 64 by the side of incidence. Thus, it is an operation of the micro-lens arrays 64 and 66 to turn an optical path to a center and to bend it. If it does in this way, the light from an emitter 28 is brought close to a parallel ray by the micro-lens array 64, incidence of more light can be carried out into the angular aperture of a lens 4, and a brighter picture can be made, and an incident ray can be brought close to a parallel ray, and an image formation performance can be raised. The number of the lens 4 related to image formation can be decreased similarly, and influence of property dispersion can be made small. In the micro-lens array 66 by the side of outgoing radiation light, the optical path of

outgoing radiation light is turned to a focus, and is bent, and an image formation performance is raised further.
[0032] The micro-lens arrays 64 and 66 pour in and form a transparent resin using a frame 8 and the fixture which is not illustrated. And the irregularity corresponding to the micro lens is formed with the fixture which is not illustrated. For this reason, thickness of the micro-lens arrays 64 and 66 can be made uniform, and it can form easily.
[0033] As a cure to flare light, 0.5-5-micrometer surface roughness was given to the lens flank front face, and the black optical-absorption resin layer covered in the example to Light Emitting Diode light. Moreover, although the transparent resin layers 10 and 12 and the black frame 8 grade were shown in addition to this, neither the transparent resin layers 10 and 12 nor frame 8 grade needs to prepare.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The important section cross section of the picture equipment of an example
[Drawing 2] The perspective diagram of an individual cylindrical lens in an example
[Drawing 3] The important section cross section of a lens array used in the example
[Drawing 4] The cross section of a lens array in the 2nd example
[Drawing 5] The important section cross section of the 3rd example
[Drawing 6] The cross section of a lens array in the 4th example
[Drawing 7] Drawing showing the cut of the flare light by the irregularity of the lens side in an example
[Drawing 8] Drawing showing the drawing mechanism of a light beam with the cut of flare light in the example
[Drawing 9] Drawing showing the reduction mechanism of the number of lenses related to the image formation in an example
[Drawing 10] Drawing showing drawing of the light beam by the micro-lens array
[Description of Notations]
2 Lens Array
4 Lens
6 Side Plate
8 Frame
10 Transparent Resin Layer
12 Transparent Resin Layer
14 Main Part of Lens
16 Surface Layer
18 Optical-Absorption Resin Layer
20 Cylinder-head Cover
22 Salient
24 Glass Substrate
26 LED Array
28 Emitter
30 Transparent Resin Layer
32 It is Frame Stop Flowing.
42 Lens Array
44 Side Plate
46 Transparent Resin Layer

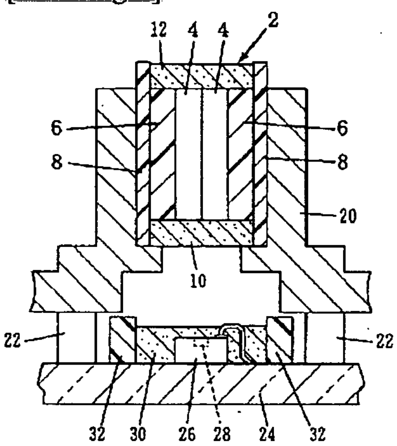
48 Transparent Resin Layer
52 Lens Array
62 Lens Array
64 Micro-Lens Array
66 Micro-Lens Array

[Translation done.]

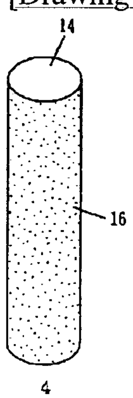
* NOTICES *

DRAWINGS

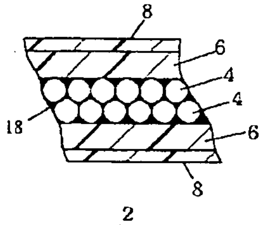
[Drawing 1]



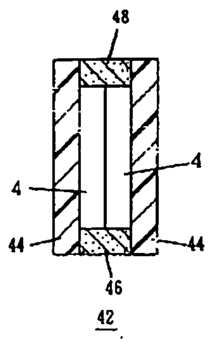
[Drawing 2]



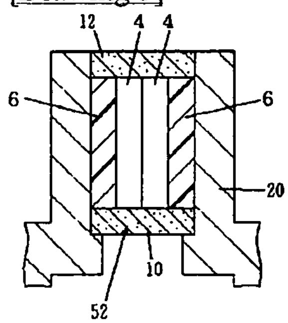
[Drawing 3]



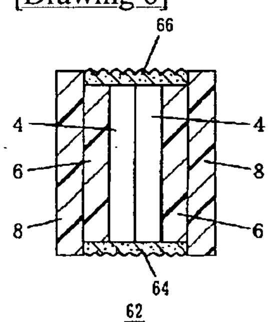
[Drawing 4]



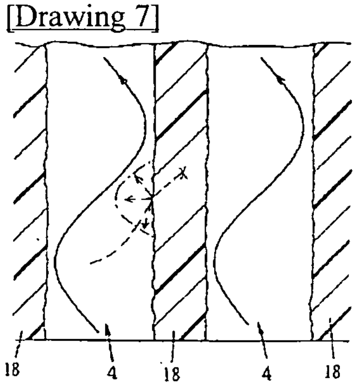
[Drawing 5]



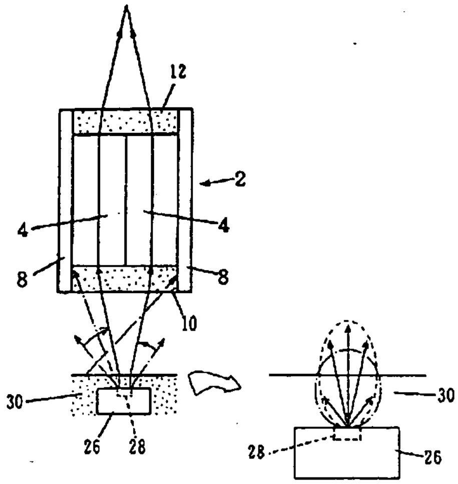
[Drawing 6]



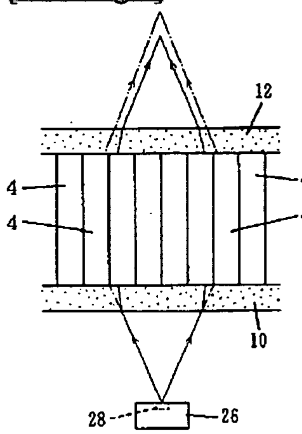
[Drawing 7]



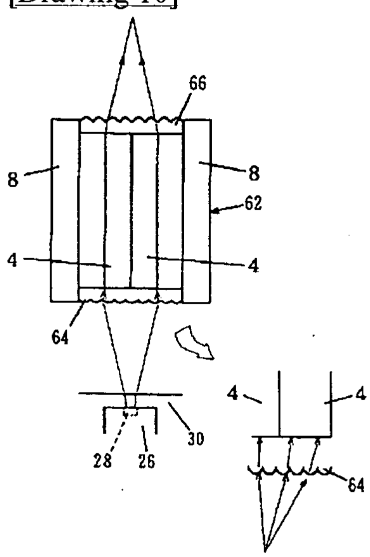
[Drawing 8]



[Drawing 9]



[Drawing 10]



[Translation done.]

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TITLE: IMAGING DEVICE

PUBN-DATE: September 9, 1994

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APPL-NO: JP05059620

APPL-DATE: February 23, 1993

INT-CL (IPC): H01L033/00, G02B027/00 , G02F001/1335 , H01L027/14

ABSTRACT:

PURPOSE: To prevent a lens array from deteriorating in imaging performance due to flare light so as to improve an imaging device in performance by a method wherein the side faces of lenses are roughened as prescribed in average roughness, and a light absorbing resin layer specified in transmissivity to light of wavelengths larger than that of operating light is provided among lenses.

CONSTITUTION: A lens array 2 is formed through such a manner that rod-like lenses 4 in continuous lengths are bound together, fixed by side plates 6, and cut into pieces. As the end face of the lens 4 is so roughened at cutting as to scatter light that travels through it, both the end faces of the lens 4 are covered with transparent resin layers 10 and 12. The side face 16 of the lens 4 is so roughened as to be 0.5 to 5μm in average roughness, and a light absorbing resin layer 18 whose transmissivity is below 20% to light of

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G02B 27/00	C	7036－2K		
G02F 1/1335		7408－2K		
H01L 27/14				
		7210－4M	H01L 27/14	D

審査請求　未請求　請求項の数1　FD　（全 7 頁）

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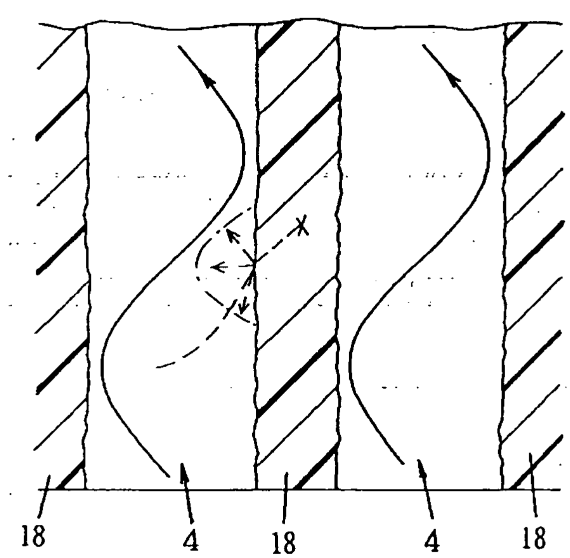
(54)【発明の名称】　画像装置

(57)【要約】
【目的】　レンズアレイのフレア光による結像性能の低下を防止し、画像装置の性能を向上させる。
【構成】　レンズアレイ２の、レンズ４の側部表面を０．５～５μｍの平均表面粗さに粗面化し、レンズ４，４間には波長６６０ｎｍ以上の光に対し透過率２０％以下の光吸収樹脂層１８を設ける。



【特許請求の範囲】

【請求項1】　棒状のレンズを多数結束したレンズアレイと、多数の受発光素子とを用いた画像装置において、前記各レンズの側部表面を粗面化して、その平均表面粗さを0.5～5μmとするとともに、
前記の各レンズとレンズとの間に、受発光素子で使用する光の波長以上の波長の光に対して、透過率が20％以下の光吸収樹脂層を設けたことを特徴とする、画像装置。

【発明の詳細な説明】

【0001】

【発明の利用分野】この発明は、LEDヘッドや密着型イメージセンサ、液晶シャッタアレイヘッド、PLZTヘッド等の受発光素子とレンズアレイとを用いた画像装置に関する。この発明は特に、用いるレンズアレイの改良に関する。

【0002】

【従来技術】LEDヘッドや密着型イメージセンサ等の画像装置では、セルフフォーカシングレンズアレイ等のレンズアレイを用いる。このレンズアレイは棒状のガラスやプラスチック等のレンズを用い、レンズには断面に沿って屈折率分布を持たせて、レンズ内での光路を決定する。レンズアレイの問題点は従来ほとんど検討されていないが、発明者はレンズアレイ内をフレア光が進み、結像性能の低下をもたらすことを見い出した。これらのフレア光は例えば結像したビームの裾をもたらし、ビームを広げる。ビームの裾の広がりは、グラフィック等の規則的パターンで問題となり、特にドットが連続したパターンで線幅の広がりを招いて、解像度を低下させる。またレンズアレイ内のあるレンズから他のレンズへと移動するフレア光は、ゴースト画像をもたらす。このゴースト画像も、多数のドットが連続した図形などで、顕著に現れる。

【0003】

【発明の課題】この発明の課題は、レンズアレイでのフレア光を遮断し、画像品位を向上させることにある。

【0004】

【発明の構成】この発明は、棒状のレンズを多数結束したレンズアレイと、多数の受発光素子とを用いた画像装置において、前記各レンズの側部表面を粗面化して、その平均表面粗さを0.5～5μmとするとともに、前記の各レンズとレンズとの間に、受発光素子で使用する光の波長以上の波長の光に対して、透過率が20％以下の光吸収樹脂層を設けたことを特徴とする。

【0005】レンズ側面の表面粗さは表面粗さ計で測定した平均表面粗さとし、結束前の棒状レンズをサンドブラストやエッチング、特にエッチングで処理して表面粗さを与える。レンズの側部表面に適切な表面粗さを与えると、1つのレンズ内を進むフレア光が側部表面の凹凸で散乱されてレンズ内を進まず、レンズの先端からフレア光が放出されるのを防止することができる。表面粗さが0.5μm未満では、粗さが波長よりも短いため、フレア光の散乱効果が小さく、0.5μmを越えることによりフレア光の防止効果が顕著となる。例えばLEDヘッドなどの画像形成装置の場合、1つのレンズ内を進むフレア光は、ビームの裾の広がりをもたらす。孤立印画ドットに対して、このフレア光は肉眼で見た印画結果（例えば感光体ドラムを用いて印画した印画結果）では目立たないが、ビーム測定機等を用いれば検出することができる。連続印画ドットでは、フレア光の重なりによりその影響が著しくなり、肉眼でも線幅の広がりとして印画品質の低下が感じられる。これに対して、レンズ側面の表面平均粗さを0.5μm以上にすると、連続印画ドットに対する肉眼での線幅の広がりが感じられないようになる。また表面平均粗さを1μm以上にすると、孤立印画ドットのビームの強度分布をビーム測定機で測定しても、ビームの裾の広がりが目立たなくなる。

【0006】表面平均粗さが5μmを越えると凹凸の付与にともなう応力集中が発生し、応力集中が集中した箇所でレンズにクラックが生じ、あるいは屈折率分布に異常が生じ、結像性能が低下する。レンズ内に発生するクラックはレンズ強度を低下させ、レンズを切断，結束してレンズアレイとする工程で、強度不足をもたらす。応力集中の発生を完全に防止し、かつ余裕を考慮すると、平均表面粗さは3μm以下が好ましい。そこでレンズ側面の表面粗さは0.5～5μm、より好ましくは1～3μmとする。

【0007】レンズとレンズの間には用いる光波長以上の波長の光に対し、透過率が20％以下の光吸収樹脂層を設け、例えばレンズをこのような光吸収樹脂層で被覆する。このような光吸収樹脂層は、例えばレンズの結束前に予めレンズ側面に塗布しておき、塗布した光吸収樹脂層に対し透過率を定義する。なおレンズ表面に光吸収樹脂層を塗布せず、結束したレンズとレンズの隙間に光吸収樹脂層を充填する場合には、レンズとレンズとの平均隙間の1／2の厚さの光吸収樹脂層があるものとして、この厚さの光吸収樹脂層に対し透過率を定める。透過率は、画像装置で用いる波長以上の波長の光に対する透過率を用い、例えば波長685nmのLEDを用いる場合、685nm±30nmの波長分布を考慮して、波長分布の短波長側の660nm以上の波長に対する透過率で定義する。ここで波長以上のとするのは、一般に長波長側（近赤外領域）で顔料等の吸光係数が小さくなり、発光波長の長波長側でフレア光が生じ易いからである。

【0008】このような光吸収樹脂層は、例えば10μm程度の膜厚で個別のレンズに塗布し、例えばシリコーン樹脂，エポキシ樹脂，アクリル樹脂等の樹脂95～60wt％と、カーボンブラック，チタンーカーボン，酸化鉄等の顔料5～40wt％の混合物等を用いる。顔料

濃度5wt%で10μmの膜厚では透過率は20%となり、40wt%を越すと樹脂中への顔料の均一分散が困難となり、局所的な透過率の増加をもたらす。より好ましい組成は、樹脂と顔料の全量を100wt%として顔料10～30wt%で、この範囲で透過率は4%以下となる。

【0009】このようなレンズアレイでは、1つのドットの結像に多数のレンズが関係する。そしてグラフィック等の規則的パターンで、レンズとレンズとの間を移動するフレア光が、ゴースト画像をもたらし、肉眼でも印画品質の低下として感じられるようになる。発明者の実験では、透過率20%以下の光吸収樹脂層を設けると、規則的パターンの印画でも、ゴースト画像が肉眼で判別できなくなり、透過率が4%以下ではビーム測定機でも規則的パターンの印画に対するゴースト画像が検出できなくなった。

【0010】画像装置には、実施例で示したLEDヘッドの他に、液晶シャッタアレイヘッドや密着型イメージセンサ，PLZTヘッド等の、レンズアレイと受発光素子を用いた画像装置を用いる。

【0011】

【発明の作用】この発明では、レンズアレイのレンズ側面を粗面化する。粗面化により、1つのレンズ内を進むフレア光はレンズ側面の凹凸で乱反射され、レンズ内を進行しなくなる。そしてフレア光は、レンズ内で散乱を繰り返す間に吸収され消滅する。次にレンズとレンズとの間を移動するフレア光を吸収するため、用いる波長に対して黒色の光吸収樹脂層を設ける。このため、あるレンズから他のレンズに移ろうとするフレア光は、光吸収樹脂層で吸収され消滅する。これらのため、1つのレンズ内を進むフレア光も、隣接したレンズ間を移動するフレア光も除去され、画像品位が向上する。

【0012】

【実施例】図1～図3に、最初の実施例を示す。図1において、2はレンズアレイで、4はガラスやプラスチック等の棒状レンズである。6は黒色の樹脂等を用いた側板で、8は同じく黒色の樹脂等を用いた枠体である。10は入射光側の透明樹脂層、12は出射光側の透明樹脂層で、入射光側の透明樹脂層10を優先して設け、出射光側の透明樹脂層12は設けなくても良い。また樹脂層10，12には顔料等を分散させ、部分的に光を吸収させるようにしても良い。

【0013】レンズアレイ2は、セルフフォーカシングレンズアレイを変形したもので、例えば長尺状の棒状レンズを結束し、側板で固定し、切断して形成する。切断時の影響により、レンズ4の端面は荒れ、光の散乱が生じる。レンズ4の端面による光の散乱を防止するため、透明樹脂層10，12で、レンズ4の両側の端面を被覆する。透明樹脂層10，12には例えばエポキシ、アクリル、ポリエステル等の樹脂を用い、屈折率がレンズ4に近いため、レンズ4の端面での光の散乱を防止することができる。これは、レンズ4と屈折率が類似の透明樹脂層10，12で端面を被覆したため、レンズ4の端面の荒れが光にとって感じられないためである。透明樹脂層10，12の厚さが不均一であるとレンズ効果が生じ、光路が直線から変化するので、枠体8，8を設けて透明樹脂層10，12を流し込み、その厚さを均一にする。

【0014】図2に、個別のレンズ4を示す。レンズ4には断面に沿って屈折率の分布があり、光は屈折率分布により導かれながら進行する。レンズ4の材質にはガラスやプラスチック等を用い、直径は例えば1.1mm程度である。レンズ4の側部表面は図2のように粗面化し、その表面粗さは表面粗さ計で測定した平均表面粗さとして0.5～5μm、より好ましくは1～3μmとする。粗面化には例えばエッチングを用いる。粗面化した表面を、表面層16として示す。

【0015】図3に示すように、レンズ4は光吸収樹脂層18で被覆する。樹脂層18の樹脂成分には例えばシリコーン樹脂を用い、顔料にはカーボンブラック，チタンーカーボン，黒色酸化鉄等の、近赤外領域で黒色の顔料を用いる。顔料添加量は、樹脂18の全重量を100wt%として、顔料5～40wt%，より好ましくは10～30wt%とする。5wt%未満では透過率は20%を越え（膜厚10μmの場合）、レンズ4から他のレンズ4へと移動するフレア光を充分吸収できない。一方顔料が40wt%を越えると、均一分散が困難となるため塗布が難しくなり、また局所的に透過率の高い部分が生じる。顔料含有量を10～30wt%とすると、透過率は4%未満となりフレア光をほぼ完全に吸収できる。図3では、レンズ4，4間の隙間に光吸収樹脂層18を充填したように示したが、例えば10μm程度の膜厚で結束前にレンズ4を光吸収樹脂層18で被覆し、同様の黒色樹脂で結束するのが好ましい。このようにすればレンズ4，4の最近接部でもレンズ4，4が直接接触せず、その間に光吸収樹脂層18を設け光を吸収することができる。また透過率は、例えばレンズ4に塗布するのと同じ厚さで、ガラス板上に塗布して測定する。

【0016】図1に戻り、画像装置の他の部分を説明する。20はプラスチック等のヘッドカバーで、内面を黒色コートしたり、あるいは黒色の樹脂を用いて、迷光を遮断するのが好ましい。22は位置決め用の突起で、24はガラスや表面をガラスグレーズしたセラミック等の基板、26はLEDアレイ、28はその発光体である。30は、LEDアレイ26をモールドするための透明樹脂層で、32は透明樹脂層30が流れ出すことを防止するための流れ止め枠である。流れ止め枠32を用いることにより、透明樹脂層30の表面を平面状にし、透明樹脂層30の表面が平滑でないことにより光路が曲げられることを防止する。LEDヘッドの他の部分は周知であ

り、説明を省略する。

【0017】図4～図6に、レンズアレイ2に対する種々の変形例を示す。図4のレンズアレイ42では、側板44を枠体に兼用する。ただしこれはレンズ4を側板44なしで結束して切断することになるので、図1のレンズアレイ2に比べて製造が難しい。46，48は新たな透明樹脂層である。

【0018】図5のレンズアレイ52では、ヘッドカバー20を枠体に兼用して、透明樹脂層10，12を形成する。この変形例では、透明樹脂層10，12の型として適当な治具を用い、ヘッドカバー20と治具とを型として、透明樹脂層10，12を流し込み、硬化させる。

【0019】図6のレンズアレイ62では、レンズ4の上下にマイクロレンズアレイ64，66を設ける。64が入射光側のマイクロレンズアレイ、66が出射光側のマイクロレンズアレイである。マイクロレンズアレイ64，66は、枠体8とマイクロレンズアレイ64，66の表面形状に応じた型とを用いて、透明樹脂を流し込んで成型する。これらのマイクロレンズは複眼レンズで、個々のレンズ4よりも径の小さなレンズを用いる。マイクロレンズアレイ64，66は、マイクロ凸レンズのアレイとし、図のようにレンズ4の外側に凸の部分を設ける。

【0020】実施例では透明樹脂層10，12等の厚さは均一であるが、厚さ自体を知ることは難しい。これは枠体8等の、厚さのばらつきのためである。また透明樹脂層30の厚さを知ることも難しい。そこで画像装置の組立後に、図示しない感光体ドラムやCCDカメラ等を用いて、最適の結像位置を探り、ヘッドカバー20の感光体ドラムへの最適取付位置を記憶する。ヘッドカバー20には、図示しない取付ネジ等を設け、このネジにより感光体ドラム等との間隔を微調整できるようにする。そして組立時に測定した最適取付位置を基に、取付ネジを微調整し、レンズアレイ2の中心に対する発光体28からの光学距離と、レンズアレイ2の中心から感光体ドラムへの光学距離とが一致するように、微調整ネジで間隔を調整する。このようにすれば、透明樹脂層10，12，30の厚さの変動により光学距離が変動しても、最適の結像性能を得ることができる。

【0021】図7～図10により、実施例の作用を示す。図7にフレア光の吸収を示す。棒状レンズ4には屈折率の分布があり、レンズ4の開口角の範囲に入った光は図の実線のように進み、レンズ側面には達しない。一方フレア光（図の破線）は開口角よりも入射角の大きな光で、レンズ4の表面層16に達して、表面層16に光の波長に匹敵する凹凸があるため散乱される。散乱光のビームを図の鎖線で示す。フレア光がレンズ4内を進むには散乱を繰り返さねばならないため、フレア光はレンズ4内を進行できず、レンズ4の先端から出射されるフレア光は極く一部となる。例えば1回の散乱で前方に散乱されるフレア光は数分の1程度で、散乱毎にフレア光は数分の1に減衰する。そして散乱を数回程度繰り返せば、フレア光は極めて小さくなり、レンズ4からの出力光としてはほぼ0になる。

【0022】あるレンズ4から他のレンズ4へ光が移動しフレア光が生じると、その間の光吸収樹脂層18によりフレア光が吸収される。光吸収樹脂層18は透過率が20％以下で、他のレンズに移るには合計の透過率が4％以下となる（透過率20％以下の層を2回通過）。

【0023】発明者は、表面層16の粗さの程度や、樹脂層18の透過率の効果について、波長685nmのLEDアレイ26を用いて検討した。レンズ4に対しては、1つのレンズ内を進むフレア光と、レンズ間を移動するフレア光の2種類があり、1つのレンズ内を進むフレア光は画像の線幅の広がりをもたらす。この効果は孤立印画ドットでは小さく、グラフィック等の規則的パターンで線幅の広がりとして感じられ、特に連続印画ドットに対して目立って現れる。フレア光はレンズ4のばらつきや発光体28のばらつき等で生じ、その程度に規則性がなく、線幅の広がり方にもばらつきがあるため、濃度むらとして感じられる。ここでレンズ4の表面層16の平均表面粗さを0.5μm以上とすると、規則的連続印画ドットに対し、a－Si感光体ドラムを用いて印画した際の濃度むらが肉眼で感じられなくなり、1μm以上ではビーム測定機を用いてもビームの裾の広がりが目立たなくなった。

【0024】レンズアレイ2はレンズ4を例えば2列に結束したもので、1ドットの結像に約7本のレンズ4が関係する。レンズ4，4間を移動するフレア光はゴースト画像をもたらし、これは特に規則的パターンで連続印画ドットの部分に強く現れる。波長660nmでの透過率が20％程度の光吸収樹脂層18でレンズ4を被覆すると、肉眼ではグラフィックパターンの連続印画ドットの印画結果に対してもゴースト画像が感じられず、透過率を4％以下にすると（顔料濃度を10wt％以上にすると）、ビーム測定機でもゴースト画像を検出することができなくなった。

【0025】なおこれらは透明樹脂層10，12や黒色の枠体8を取り外した際の結果で、これらのものを用いれば、レンズ4の端面での散乱等のフレア光の原因自体を除き、フレア光の影響をさらに小さくすることができる。

【0026】図8～図10に移り、レンズ4の端面には、切断時の影響により荒れがある。荒れを放置すると光が散乱されるが、透明樹脂層10，12で被覆し、透明樹脂層10，12とレンズ4との屈折率が近いことを利用して、荒れの影響を防止する。

【0027】図8に示すように、透明樹脂層10の屈折率は周囲の空気よりも高いため、発光体28からの光は透明樹脂層10に入ると平行光線に近づき、光ビームが

集束する。このためレンズ4で本来利用することができない広角での入射光も、レンズ4で結像させることができ、より明るい画像を形成できる。また透明樹脂層10で事前に入射光を平行ビームに近づけると、レンズ4の負担が軽減し、結像性能を向上させることができる。さらにゴースト画像の原因となる光は、黒色樹脂の枠体8に入射して吸収される。なおここで黒色という意味は、用いる光の波長以上の波長の光に対して黒色という意味で、実施例の場合、LEDアレイ26の発光波長以上の波長で黒色であれば良い。また透明樹脂層10に黒色顔料等を分散させると、透明樹脂層10に広角で入射した光を、透明樹脂層10内での移動距離が長いため優先的に吸収し、フレア光をさらに除くことが出来る。

【0028】実施例では、LEDアレイ26を保護するためと、レンズアレイ2への入射光を強めるために、透明樹脂層30でLEDアレイ26を被覆する。これは発光体28と空気との屈折率の差が大きいため、出力光の一部が空気との界面で反射し、発光体28内に閉じ込められるからである。そこで発光体28と空気との中間の屈折率の樹脂層30を介在させ、発光体28への光の閉じ込め効果を防止する。次に透明樹脂層30の両側に流れ止め枠32を設け、低粘性の樹脂を用いて透明樹脂層30を形成し、透明樹脂層30の表面を平面状にする。発光体28からの光は、透明樹脂層30が無い場合、図8の右下の鎖線のビームのように広がる。これに対して透明樹脂層30を設けると、屈折率が空気よりも大きいため、ビームを図8の破線のように絞り、指向性の高い光ビームを取り出すことができる。また透明樹脂層30を設けると、透明樹脂層30の屈折率と空気との屈折率との差と、透明樹脂層30の厚さの積の値だけ、LEDアレイ26をレンズアレイ2の側に光学的に近づけたことになる。この結果、途中での光ビームの広がりを防止し、レンズアレイ2への入射光を強めることができる。

【0029】レンズアレイ2から図示しない感光体ドラムの側へ出射する光は、透明樹脂層12を通る。そして透明樹脂層12の屈折率がレンズ4の屈折率に近いことを用いて、レンズ4の出射側の端面の荒れの影響を解消する。

【0030】レンズ4，4間のばらつきへの対策を、図9により説明する。レンズ4には結像性能のばらつきがあり、結像に関係するレンズ4の本数が多い程、ばらつきの影響が増す。透明樹脂層10の屈折率は空気の屈折率よりも大きいので、発光体28からの光は、透明樹脂層10に入ると平行光線に近づき、図9に実線のように、結像に関係するレンズ4の本数が減少する。この結果、レンズ4，4間の特性ばらつきの影響が小さくなる。

【0031】図10に、マイクロレンズアレイ64，66の作用を示す。マイクロレンズアレイ64，66は凸レンズのアレイとし、入射側のマイクロレンズアレイ64では、発光体28から広がりながら入射する光を平行光線に近づけ、出射側のマイクロレンズアレイ66では、出射光を焦点へ向けてさらに絞る。このように光路を中央へ向けて曲げることが、マイクロレンズアレイ64，66の作用である。このようにすると、発光体28からの光をマイクロレンズアレイ64で平行光線に近づけ、より多くの光をレンズ4の開口角内に入射させてより明るい画像を作り、また入射光線を平行光線に近づけて結像性能を向上させることができる。同様に結像に関係するレンズ4の本数を減少させて、特性ばらつきの影響を小さくすることができる。出射光側のマイクロレンズアレイ66では、出射光の光路を焦点へ向けて曲げ、結像性能をさらに向上させる。

【0032】マイクロレンズアレイ64，66は、枠体8と図示しない治具とを用いて、透明樹脂を注入して形成する。そして図示しない治具により、マイクロレンズに対応した凹凸を形成する。このためマイクロレンズアレイ64，66の厚さを均一にし、かつ容易に形成することができる。

【0033】実施例では、フレア光への対策として、レンズ側部表面に0.5～5μmの表面粗さを与え、LED光に対し黒色の光吸収樹脂層で被覆した。またこれ以外に、透明樹脂層10，12や黒色の枠体8等を示したが、透明樹脂層10，12や枠体8等は設けなくても良い。

【0034】

【発明の効果】この発明では、レンズアレイでのフレア光を除去し、画像品位を向上させることができる。

【図面の簡単な説明】

【図1】 実施例の画像装置の要部断面図

【図2】 実施例での、個別棒状レンズの斜視図

【図3】 実施例で用いたレンズアレイの要部断面図

【図4】 第2の実施例での、レンズアレイの断面図

【図5】 第3の実施例の要部断面図

【図6】 第4の実施例での、レンズアレイの断面図

【図7】 実施例での、レンズ側面の凹凸によるフレア光のカットを示す図

【図8】 実施例での、フレア光のカットと、光ビームの絞り機構を示す図

【図9】 実施例での、結像に関係するレンズの数の減少機構を示す図

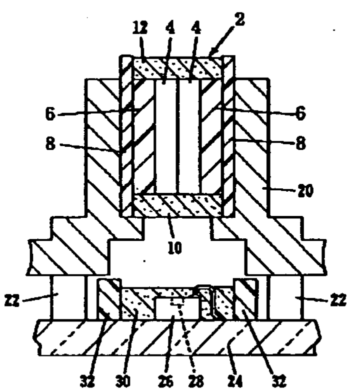
【図10】 マイクロレンズアレイによる光ビームの絞りを示す図

【符号の説明】

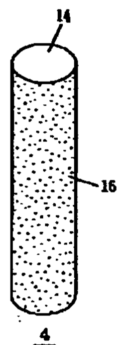
2 レンズアレイ
4 レンズ
6 側板
8 枠体
10 透明樹脂層
12 透明樹脂層

14　レンズ本体
16　表面層
18　光吸収樹脂層
20　ヘッドカバー
22　突起
24　ガラス基板
26　LEDアレイ
28　発光体
30　透明樹脂層
32　流れ止め枠
42　レンズアレイ
44　側板
46　透明樹脂層
48　透明樹脂層
52　レンズアレイ
62　レンズアレイ
64　マイクロレンズアレイ
66　マイクロレンズアレイ

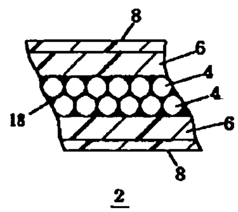
【図1】



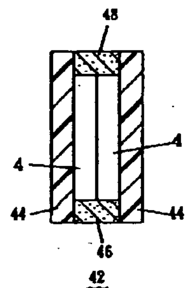
【図2】



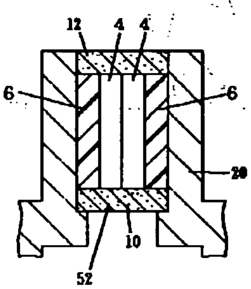
【図3】



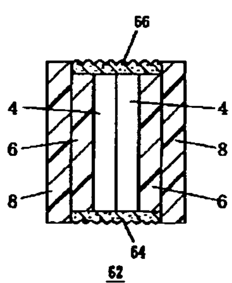
【図4】



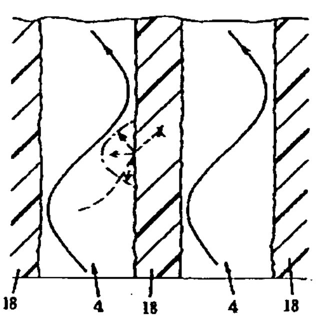
【図5】



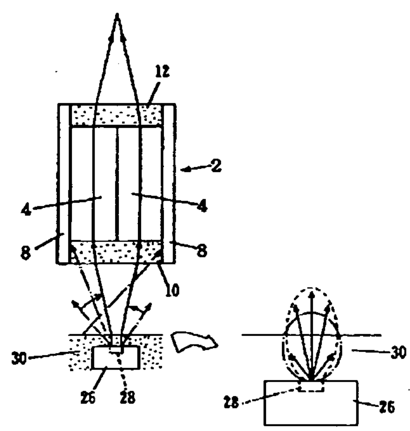
【図6】



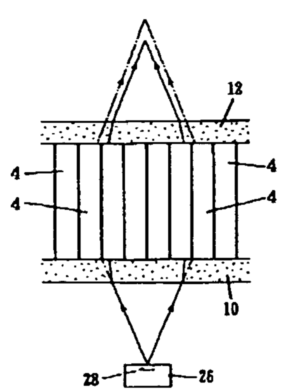
【図7】



【図8】



【図9】



【図10】